RICULTURAL ECONOMICS RESEARCH

JULY 1980 VOL. 32 NO.3

"If I have seen further, it is by standing on the shoulders of giants."

Isaac Newton

AGRICULTURAL ECONOMICS RESEARCH

A Journal of the U.S. Department of Agriculture • Economics, Statistics, and Cooperatives Service

Readers interested in a chronological bibliography of materials in *Agricultural Economics Research* from the first issue in 1949 through the last issue in 1979 should write Ann Bassett, Staff Assistant, ESCS/EDD, U.S. Department of Agriculture, Washington, D.C. 20250.

IN THIS ISSUE

"If I have seen further," said Isaac Newton in a letter to Robert Hooke, "it is by standing on the shoulders of giants." This graphic aphorism summarizes a popular view of the process by which knowledge accumulates.

The aphorism has a long and interesting history. Its historian, Robert K. Merton, has traced through the centuries references to dwarfs and pygmies standing, sitting, or otherwise perched on the shoulders of giants. He identifies its origin with a remark in the early 12th century by Bernard of Chartres. Many of Merton's historical references imply that the aphorism has long been a part of folklore. In these days of increased sensitivity to civil rights issues, the aphorism may be awkward. Nonetheless, we can say—in the spirit of its use over the centuries—that each author in this issue sees a little farther by standing on someone's shoulders.

In the first article, Bessler and Schrader apply a concept known as Granger Causality to the problem of providing a causal explanation of the price of turkeys in terms of the prices of various turkey parts. C. W. J. Granger, who cites in his footnotes the names of people on whose shoulders he stood, has observed that for economic systems the direction of causality is highly debatable. Using Granger's technique for examining causality in economic systems, Bessler and Schrader perceive that prices of turkey breasts are causally related to prices of whole birds which, in turn, appear causally related to tail and wing prices.

The rural segment of the U.S. population has been increased in recent years by urban-to-rural migration. This demographic change has raised a number of research questions about the social and economic characteristics of migrants and nonmigrants as well as commuters and noncommuters. Bowles and Beale, by standing on the shoulders of statisticians at the U.S. Bureau of the Census who have provided a new data source, discern important attributes of migrants and commuters. They note, for example, the likelihood that urban-to-rural migrants will commute from their new rural residences to urban work places.

Giants of the past have provided present-day agricultural economists with valuable research tools. In the third article, Williams combines two of these tools—the concept of a tradeoff curve and the computational procedure called linear programming—to visualize economic development planning in a rural-oriented, multicounty region. Williams sees a conflict between the interests of management and the interests of labor in a developing region. A region can grow efficiently toward the goals of either group or toward compromise. Resolutions of such conflicts have implications for a region's future economic and social environment.

CLARK EDWARDS

CONTENTS

MEASURING LEADS AND LAGS AMONG PRICES: TURKEY PRODUCTS

By David A. Bessler and Lee F. Schrader*

The study applies the Haugh procedure for establishing Granger causal orderings among prices for whole turkeys and turkey parts. Breast prices and a yield-weighted index of parts prices led tom prices by 1 day. The reduction in uncertainty about tom prices in one period gained from knowledge of breast prices in the prior period is of little economic significance. Results for canner prices relative to parts prices are similar.

Keywords

Causality
Leads and lags
Dynamic regression
Pricing
Price reporting

INTRODUCTION

Marketing economists, government, and market participants are paying increasing attention to commodity pricing system performance (*10*).[1] The pricing system for turkeys has characteristics which have created problems in other commodity pricing systems. Coordination of production and processing through contracting and integration has all but eliminated a spot market for live turkeys. Proliferation of product variations, formula pricing, and fewer turkeys marketed as plain, whole, and frozen birds have led system participants to ask why live birds are still priced based on the quote for processed whole birds. Price sensitivity and quality (whether due to reporting failure by market participants or reporters) have been questioned (*18*).

This article explores the lead-lag relationships between prices of a subset of over 100 turkey product prices reported in the *Producers' Price-Current* of Urner Barry Publications, the most widely used source of such information in the United States. We include in the comparisons an index of turkey part prices weighted to show the part they represent of the whole turkey.

We investigate the relationships between different product prices at different times (leads and lags) for two reasons. First, given the large number of items quoted each day, one would expect reporters to vary the amount of attention they can give to each product price. Thus, some prices may be more sensitive to changing conditions and lead others in time. Second, the demand for whole turkeys for further processing (an alternative to sale as a fresh or frozen bird and a potential use for any turkey of sufficient size) stems from consumer demand for parts or further processed products. One would expect that prices of some parts would lead those of whole birds, particularly the price of canner turkey (bulk-packed, fresh, without neck and giblets) which is destined for further processing. Such price leading refers to only major parts (especially turkey breast). We do not expect minor parts such as the skin or tail to have strong leading tendencies.

The methodology used in this article centers on the empirical specification of dynamic relationships between alternative variables (series). To date, most econometric research has involved estimating relationships specified *a priori*. Typically, knowledge of these is based on economic theory or constraints peculiar to the system analyzed. For example, countless empirical studies have been grounded in the theory of the firm or the consumer. Generally, this theory has provided justification for zero-one type restrictions in econometric equations (variable X belongs or does not belong in a particular equation). Economic theory has also been used to provide inexact prior information; for example, instead of including or excluding variable X in a relationship, the researcher posits that inexact restrictions make the coefficient associated with the variable positive (*17*). Often, however, *a priori* specification cannot be done because the analyst does not know the "correct" theory. For example, in constructing dynamic models, theorists are not always explicit on the leads and lags which drive the system (*13*, p. 227). Or, economists may have two, three, or more competing theories from which to choose—each yielding different policy recommendations for a given problem. When a theory is ambiguous on explicit time-related properties, the method we use can be applied to help the analysts decide

*The authors are Assistant Professor and Professor, respectively, Department of Agricultural Economics, Purdue University, West Lafayette, Indiana. This research represents a contribution to a cooperative research project with ESCS to improve performance of the turkey pricing system. It is Journal Paper Number 8021 of the Purdue University Agricultural Experiment Station. Helpful comments by an anonymous referee and the editors of this journal are gratefully acknowledged.

[1] Italicized numbers in parentheses refer to items in the references at the end of this article.

on the theory to use.[2] While the method we use here has been the focus of considerable debate (see *21*) over the last 5 years, it now represents (in the words of Feige and Pearce) "an essential element of the economist's tool kit" (*5*, p. 532).

GRANGER CAUSALITY METHOD

The analysis applied here generally fits under the heading of Granger causality. The method provides a means for establishing lead-lag (predictive) relationships among two variables reported in a time series. More specifically, a variable X causes another variable Y, for a given universe that includes at least X and Y, if current values of Y can be predicted better by using past values of X than by not doing so, other things being equal. The method has been used before, probably the most well known applications are (*19*) and (*14*). A recent article by Bishop in this journal provides a good review of the method (*2*).

In general, it is hard to detect causality by analyzing cross correlations or regressions of levels of Y on past levels of X and Y. In particular, the significance tests (*t* and F statistics) obtained from relating levels of highly autocorrelated series can be grossly overestimated, which could lead us to assert a causal relation when none exists. Granger and Newbold, in an example of improper inference, demonstrate that high values of the coefficient of determination (R^2) can be obtained for regressions of one random walk on another (*7*). They conclude that unless caution is used with time series, essentially false regressions can be mistaken for genuine relationships.

As an alternative, Haugh suggests that we consider the innovations of each series (*8*). That is, he suggests that we first remove all time series properties from each series—that we filter both series using procedures of, say, Box and Jenkins (*3*). The innovation of a particular time series refers to that part which cannot be explained in terms of its own past. Innovation is used because it represents the new information available at time *t* for forecasting future periods (econometricians might prefer to use the term "error" to denote the same concept, which is perfectly acceptable).

The idea of filtering (or prefiltering) data before attempting to make causal inference between series, while relatively new in economics literature, has been known to statisticians for some time. Indeed, R. A. Fisher (in the first quarter of this century) suggested that one prefilter data with polynomial trend models (*6*).

Since Fisher's early writing on the subject, more general filtering procedures have been developed. While possible filters are many, those used here fit into the class of autoregressive, integrated, moving-average (ARIMA) processes. Some researchers may find it useful to view prefiltering as removing all time-related dependence, such as trends, cycles, or seasonal effects, from each series. We chose the Box and Jenkins procedures because they offer a rich, well-developed, easily obtained set of procedures and computer programs. Other methods are available (see *1* and *12*). An alternative procedure may provide a better path than ours to finding appropriate prefilters in specific cases.[3]

Pierce and Haugh demonstrate that variable X causes Y if the cross correlations between the innovations from each transformed series are nonzero at positive lags—that is, if current Y can be predicted by past X.

Other causal relations involving instantaneous causality, feedback, and independence can be analyzed by these same cross correlations. For example, if the cross correlation is nonzero at a lag of zero, and no two-way causality exists, instantaneous causality exists. Or, if nonzero cross correlations exist at both positive and negative lags, then a two-way or feedback relation exists between X and Y.

The actual test of these cross correlations must, of course, be carried out with estimated cross correlations. Haugh has demonstrated that, under the null hypothesis that series X and Y are not causally related, r_k, the estimated cross correlations, are asymptotically independent and normally distributed with zero means and standard deviations of $1/\sqrt{n}$. Thus, we can test using Haugh's U statistic:

[2] For more on the use of empirical methods to sort out "correct" theory, see A. W. Burks (*1*). He discusses the choice among completing theories of universal gravitation of Kepler and Newton. While deduction—mathematics and *a priori* reasoning—was required to determine the truth of these competing theories, it was not sufficient.

[3] Hsiao apparently feels this about Akaike's autoregressive "final prediction error" criterion (see *11*). In particular, Akaike's method takes some of the judgmental work out of time-series filtering.

There seems to be no consistent lead-lag pattern from parts prices to whole bird prices or from whole bird to parts prices.

$$U_m = n \sum_{k=1}^{m} r_k^2 ,$$

where n refers to the number of observations on the innovations of X and Y, r_k^2 the squared cross correlations at lag k, and m is an integer, greater than or equal to one, chosen large enough to include expected nonzero coefficients. Under the null hypothesis of series independence, the U statistic will be distributed χ^2 with m degrees of freedom. For large empirical U values, we want to reject the hypothesis of series independence. More explicitly, we can test for causality running in either direction (X causes Y ($X \rightarrow Y$) or Y causes X($Y \rightarrow X$)) by cross correlating the innovations of X_t (call these u_t) and the innovations of Y_t (call these (v_t). Considering first correlations of u_t and v_{t+k} for $k = 1,2, \ldots, m$, we reject the hypothesis of series independence and thus infer causality from X to Y if U_m exceeds the tabular χ^2 (m) at a predetermined level of significance. Conversely, considering the cross correlations of v_t and u_{t+k} for $k = 1,2, \ldots . m$, can give us an analogous U_m statistic to test causality running from Y to X.

Sims and Pierce and Haugh have pointed out problems associated with the application of the test statistic. Most of these problems mean that we fail to reject the null hypothesis of series independence when we should reject it. In particular, once we reject the hypothesis of series independence going one way, say from X to Y, the test statistic tends to underestimate the level of significance for causality running in the other direction, from Y to X (feedback). This problem is being researched, and currently no convenient alternative exists. Pierce suggests that where one is seeking empirical evidence on how the world works this underestimation is not likely a serious limitation (*14*). The selection of the integer m is also bothersome; problems can arise from selecting it "too small" or "too large." Thus it is suggested that one give prior thought to selection of m; it should not be selected arbitrarily, but rather according to one's prior expectations on leads or lags (*14*).

APPLICATION OF HAUGH'S CAUSALITY METHOD

We now apply Haugh's two-step procedure to the 1978 daily price quotes on seven of the turkey products and the turkey parts index. We excluded the minor parts (trim and skin); skin price did not change during 1978. We will analyze only the influence of parts prices on whole birds prices and whole birds prices on parts prices; we exclude relationships among parts. Weights used in construction of the price index are shown below:[4]

Item	Index weight
Young toms, 20-22 pounds	not applicable
Canner packed, 20 pounds and up	not applicable
Boneless, skinless breast	0.260
White trim	.011
Dark trim	.012
Whole wing	.117
Boneless, skinless thigh	.135
Drum	.130
Tail	.018
Skin	.080

[4] The weights represent the percentage of weight of tom turkeys attributed to each part. The weights do not sum to one because turkey bone has no economic value.

Following Haugh's approach, we filter each series separately to remove all time series properties which can be identified in each series. To do so, we apply the three-step procedures of Box and Jenkins. Readers interested in the autocorrelation and partial autocorrelation functions on each series can obtain these by writing to us. We found that all time series properties in each series could be removed using an integrated moving-average process of order 5 (this reflects a weekly regularity in price quotes).

$$(1\text{-}B)P_t = (1\text{-}\theta_1 B^1\text{-}\theta_2 B^2\text{-}\theta_3 B^3 \text{-}\theta_4 B^4\text{-}\theta_5 B^5)e_t$$

Here P_t refers to the price of a particular turkey product in period t; B, the usual lag operator ($B^i P_t = P_{t-i}$); θ_i, a moving-average term to be estimated for each series; and e_t, the error or innovation in the process in period t. We estimated a separate filter of this class for each turkey product. To test the adequacy of this model, we applied Box and Pierce's Q statistic to the residuals estimated from use of this model over the fit period (usual procedure). The Q statistic resembles the U statistic described above. While U is formed with squared cross correlations at lags $1,2, \ldots, m$, Q is formed with squared autocorrelations at lags $1,2, \ldots, m^*$. If we have prefiltered correctly, no autocorrelation should exist in the residuals (innovations) of each series. Under the null hypotheses of independent residuals (of the same series), Q is distributed χ^2 with m^*-5 degrees of freedom. The Q statistics appear in table 1.

Table 1—Calculated Q statistic applied to residuals from filter to turkey price series

Price	Calculated Q[1]
Tom turkeys	15.12
Canner turkeys	8.39
Breast	13.50
Thigh	15.01
Wing	17.28
Drum	3.45
Tail	4.33
Index of parts	12.45

[1] $\chi^2_{.05(14)}$ is 23.7. In all cases the Q statistic is below this value. Thus, we cannot statistically distinguish the residual from a random series.

In all cases, the Q statistic falls well below the χ^2 value for 14 degrees of freedom. To illustrate further the adequacy of the applied filter, we list the first 10 autocorrelations of observed residuals (table 2). The autocorrelations are all relatively low which suggests no serious departure from white noise (independent) residuals.

Following Haugh's two-step procedure, we cross correlated the innovations (residuals) from each series at lags of 30 days in both directions. Causality tests are summarized in table 3. Here we list the calculated U statistics for 24 bivariate comparisons among turkey price series. We have calculated two U statistics for each comparison. We give U_2 for short lags. We decided that important leads and lags, if they exist, would be observed at short periods—one or two periods. We calculated U_{10} to attempt to capture any longer lead-lag relationship. Our prior beliefs did

Table 2—Autocorrelations of residuals from the application of filter to each turkey price series[1]

Price series	1	2	3	4	5	6	7	8	9	10
Tom turkeys	-0.04	-0.04	-0.02	-0.05	-0.05	-0.09	-0.06	-0.00	-0.10	-0.07
Canner turkeys	- .01	- .01	- .02	- .01	- .00	.11	.02	- .07	.11	.03
Breast	- .00	- .00	.03	.03	.02	.07	.01	.13	.04	.01
Thigh	.01	.02	.01	.02	.02	.15	.11	.05	.08	.07
Wing	.00	- .00	.00	.01	.00	.10	- .01	.05	.11	.04
Drum	- .00	- .00	- .00	- .00	.00	- .00	.05	- .01	- .06	.09
Tail	- .01	- .01	- .01	.00	.00	- .01	- .01	- .01	.13	- .01
Index of parts	.01	.00	.02	.02	.03	.09	.02	.10	- .00	.08

[1] Asymptotic standard errors are 0.07 at low lags.

Table 3—Calculated U statistics for alternative causal orderings of turkey prices[1]

Turkey part	Tom turkeys		Turkeys for canning	
	As effect	As cause	As effect	As cause
Index:				
U_2	[2]6.19	1.35	1.95	3.44
U_{10}	14.81	8.54	11.80	12.74
Breast:				
U_2	[2]12.28	.16	3.22	4.02
U_{10}	[3]18.33	7.08	15.68	18.02
Thigh:				
U_2	.84	1.68	.66	5.05
U_{10}	10.37	6.97	8.81	9.53
Wing:				
U_2	.92	[2]6.33	.44	1.00
U_{10}	7.26	13.77	7.78	8.84
Drum:				
U_2	.64	1.25	3.38	3.34
U_{10}	18.09	14.29	12.32	4.84
Tail:				
U_2	.68	[2]11.96	2.87	[2]28.12
U_{10}	3.56	[3]38.76	10.01	[3]61.53

[1] Only a small subset of all possible price comparisons appear here. The focus is on parts prices that lead or lag whole turkey prices.

U_2 is calculated from the first two cross correlations (lags 1 and 2). It is distributed χ^2 with two degrees of freedom. The critical value for rejecting the hypothesis that the two cross correlations come from random series is 5.99 at the 5-percent level.

U_{10} is calculated from the first 10 cross correlations (lags 1 through 10). It is distributed χ^2 with 10 degrees of freedom. The critical value of rejecting the hypothesis that the 10 cross correlations come from random series is 18.30 at the 5-percent level.

[2] Values are above the critical value of 5.99.

[3] Values are above the critical value of 18.30.

Our primary purpose here was to look for an individual part series which could be seen as a leading indicator of whole bird prices.

not admit leads and lags encompassing more than 10 quotes.[5]

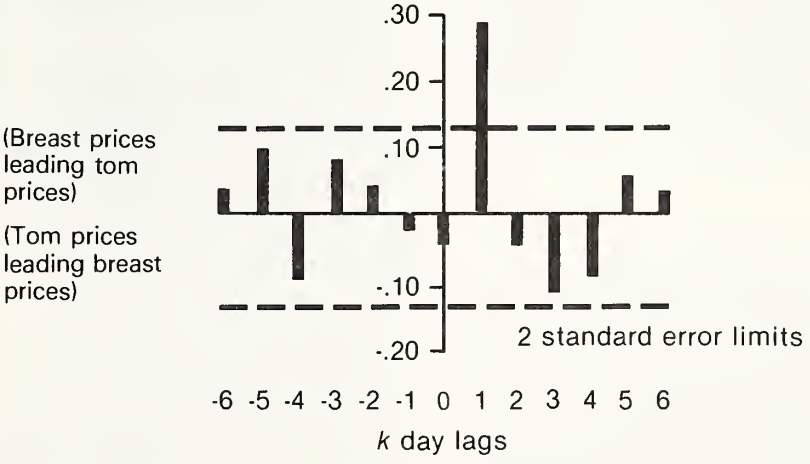
The results summarized in table 3 provide little evidence to suggest that whole bird prices lead the individual parts prices. While tom prices do tend to lead whole wing and tail, they do not lead breast, thigh, drums, or the index of parts. A similar argument holds for canner prices. That is, while canner prices clearly lead tail prices, we observed no significant ordering for canner prices and the other parts prices.

At least some of the turkey parts prices lead the whole bird prices. A strong relationship is found between breast and tom prices—at both low and high lags. Further, the index series leads toms at low lags. No significant causal relationship runs from the prices of other bird parts to either toms or canner prices.

Note from table 3 that, where evidence of causality is found, no reverse or feedback causality accompanies it. That is, we observe, say, breast prices leading tom prices at low and high lags, but we do not observe a symmetric relation in which tom prices lead (feed back on) breast prices. Thus, one can build a dynamic regression model that links the price series of toms to that of turkey breasts. Such a model will in general improve our ability to forecast tom prices beyond that achieved by using only past tom prices. If we observe feedback relations we cannot build a dynamic regression (*9*). We must rely on more general bivariate methods. These are not considered here.

To show the type of dynamic regression model which can be constructed, we consider the cross correlations between turkey breast and tom prices in greater detail (chart). Cross correlations between the innovations on breast prices and whole turkey prices are plotted at positive lags (breast leading toms) and negative lags (toms leading breast).

Cross Correlations Between Innovations on Breast and Tom Turkey Prices



Note: $(1/\sqrt{n} = 0.07)$.

[5] An anonymous referee suggested we also report the critical regions for the table as a whole. While we did not originally want to make an overall test (we were looking for significant individual relations), under some conditions we think this overall test makes some sense. That is, to require that the chance of making a type-I error for the entire table be 0.05, we must use a 0.002 significance level on each individual relation. The critical χ^2 values at a significance level of 0.002 for 2 and 10 degrees of freedom are 12.38 and 27.66, respectively. While we do not test each individual relation against this overall significance level, we report it for completeness.

Dotted lines in the figure represent the usual two standard error limits. Note that only the cross correlation at lag one exceeds this interval. Thus, we regressed the innovations on tom turkey prices in period t on the innovations of turkey breast prices in period t-1. Our results from this regression are:

$$e_{T,t} = \underset{(2.65)}{0.05} + \underset{(3.57)}{0.10} e_{B,t-1};$$

$$\text{d.w.} = 2.03^{6}$$

While our degree of explanation is low ($R^2 = 0.06$), we observe a significant coefficient on the breast innovations variable. We can now substitute the expressions for $e_{T,t}$ and $e_{B,t-1}$ back into our univariate series representations of tom and breast prices. We can then forecast future values of the tom price series based on knowledge of past errors (innovations) in the breast representation.

The residual standard error from the univariate tom series was 0.272. This error was reduced to 0.257 or about 6 percent, with the additional knowledge of the previous innovations (errors) in the univariate breast series.

[6] Entries in parentheses are t statistics, associated with the null hypothesis that the coefficients are zero. The $e_{T,t}$ refers to innovation in tom prices and $e_{B,t}$ to innovation in breast prices. The Durbin Watson (d.w.) statistic is used to assess any first-order correlation pattern in the residuals of this regression. The calculated statistic does not lead us to suspect first-order autocorrelation in the residuals of this regression.

CONCLUSIONS

There seems to be no consistent lead-lag pattern from parts prices to whole bird prices or from whole bird to parts prices. Breast prices (tested individually) lead whole bird prices by 1 day. However, other parts—tail and possibly wing—seem to follow the whole bird prices. Of course, we did not test for parts leading other parts. One would have to make such a test to make a proper statement on relation among parts. Conceivably, the strong relation between prices of tails and toms results from the fact that both series follow breast prices but at different time lags.

Our primary purpose here was to look for an individual part series which could be seen as a leading indicator of whole bird prices. Breast prices based on table 3, should be considered as a candidate (at least for tom prices). However, further study, particularly the dynamic regression between the innovations of toms in t and the innovations of breast in t−1, suggests that little uncertainty is reduced due to prior knowledge of breast prices.

Some have questioned the accuracy or sensitivity of price quotations for whole, frozen, ready-to-cook turkeys, which are usually used as a base for live bird pricing formulas. The number of reportable transactions involving the plain whole bird represented by the quote has been declining as more product is sold cut up, as further processed, or as a branded or otherwise differentiated whole turkey. Thus, we asked if a value index based on parts, or a subset of parts prices, is a better indicator of turkey value than the whole turkey quote.

We assume that, over a period of time, the whole bird quote will reflect market clearing (equilibrium) value. Likewise, the set of parts prices, weighted by yield of the parts, will, in time, reflect equilibrium value. Individual parts prices need not reflect whole bird values.

If one (or a specific set) price series can be shown to lead another related series, we consider it evidence that the leading series more accurately indicates changes in equilibrium value. This is particularly important for turkeys as formula prices at one stage are based on prices at another stage. If one price or set can be shown to lead another, that leading series is the better pricing base.

The yield-weighted parts prices would be expected to indicate change in turkey value. But such an index does not lead or lag frozen, whole bird quotes significantly. Thus we find no reason to suggest use of a parts price index. Nor do we consider the reduction in residual error gained by using the breast prices to be operationally significant.

The methods applied in this study can be used to identify leads and lags in other price series. They could also help in efforts to compare the sensitivity or accuracy of price reporting or of the price discovery process.

REFERENCES

(1) Akaike, H. "Autoregressive Model Fitting for Control." *Annals of the Institute of Statistical Mathematics*, 22, 1970, pp. 163-80.

(2) Bishop, Robert V. "The Construction and Use of Causality Tests," *Agricultural Economics Research*, 31(4), 1979, pp. 1-6.

. . . we find no reason to suggest use of a parts price index. Nor do we consider the reduction in residual error gained by using the breast prices to be operationally significant.

(3) Box, G. E. P. and G. M. Jenkins. *Time-Series Analysis: Forecasting and Control.* Holden-Day, San Francisco, 1970.

(4) Burks, Arthur W. *Chance, Cause, Reason.* Chicago: Univ. of Chicago Press, 1977.

(5) Feige, Edgar L., and Douglas K. Pearce. "The Casual Causal Relationship Between Money and Income: Some Caveats for Time Series Analysis." *The Review of Economics and Statistics*, 61, 1979, pp. 521-33.

(6) Fisher, R. A. "Contribution to the Discussion of the Paper 'On the Time Correlations Problem,' by G. U. Yule," *Journal of the Royal Statistical Society*, 84, 1921, pp. 534-36.

(7) Granger, C. W. J., and Paul Newbold. "Spurious Regressions in Econometrics," *Journal of Econometrics*, 2, 1974, pp. 111-20.

(8) Haugh, L. D. "The Identification of Time Series Interrelationships with Special Reference to Dynamic Regression Models." Unpublished Ph.D. dissertation, Statistics Department, Univ. of Wisconsin, Madison, 1972.

(9) Haugh, L. D., and G. E. P. Box. "Identification of Dynamic Regression (Distributed lag) Models Connecting Two Time Series." *Journal of the American Statistical Association*, 72(357), Mar. 1977, p. 121.

(10) Hayenga, Marvin L. (ed.), *Pricing Problems in the Food Industry (with Emphasis on Thin Markets)*. North Central Regional Project-117, Monograph No. 7, Feb. 1979.

(11) Hsiao, Cheng. "Causality Tests in Econometrics," *Journal of Economic Dynamics and Control*, 1, 1979, pp. 321-46.

(12) Mehra, Yash P. "Money, Prices and Causality," *Journal of Political Economy*, 85(1977), pp. 1227-44.

(13) Nerlove, Marc. "Lags in Economic Behavior," *Econometrica*, 40, 1972, pp. 221-51.

(14) Pierce, D. A. "Relationships—and the Lack Thereof—Between Economic Time Series, with Special Reference to Money and Interest Rates. *Journal of the American Statistical Association*, Vol. 72, 1977, pp. 11-22.

(15) Pierce, D. A. and L. D. Haugh. "Causality in Temporal Systems." *Journal of Econometrics*, Vol. 5, 1977, pp. 269-92.

(16) *Producers' Price Current*, Urner Barry Publications, Toms River, N.J.

(17) Rothenberg, Thomas J. *Efficient Estimation with A Priori Information*, Cowles Commission Monograph 23, 1973.

(18) Schrader, L. F., and M. G. Lang. *Turkey Pricing in the U.S.* Unpublished manuscript, Dept. of Agricultural Economics, Purdue Univ., 1979.

(19) Sims, C. "Money, Income and Causality." *American Economic Review*, Vol. 62, 1972, pp. 542-52.

(20) Sims, C., (ed.), *New Methods in Business Cycle Research: Proceedings from a Conference*, Federal Reserve Board of Minneapolis, 1977.

(21) Sims, C. "Comment on Relationships—and the Lack Thereof—Between Economic Time Series, with Special Reference to Money and Interest Rates." by D. A. Pierce. *Journal of the American Statistical Association*, Vol. 72, 1977, pp. 23-24.

COMMUTING AND MIGRATION STATUS IN NONMETRO AREAS *

By Gladys K. Bowles and Calvin L. Beale†

A fifth of employed nonmetropolitan household heads engaged in intercounty job commuting in 1975. Such commuting was positively associated with income, but not with education. Only a sixth of recent migrants to nonmetro communities from metro areas continued work at metro jobs, indicating a general severing of metro economic ties by such migrants. The median distance traveled to work by nonmetro household heads was well below that traveled by metro heads. Although there are more long-distance commuters among nonmetro residents, there are also many more who travel very short distances.

Keywords

Commuting
Journey to work
Migration
Population
Household heads

INTRODUCTION

The 1865 census of the State of New York provides the first evidence of official interest in the relationship between place of residence and location of employment. A question was asked "on the usual place of employment, if out of the city or town where the family resides." Unfortunately, the results were considered "too meager." Figures were published "only for the counties upon the Hudson and on Long Island and Staten Island," and a recommendation was made that the subject not be pursued (*7*).[1]

Only much later, when the automobile became the primary mode of transportation and contributed to the growth of suburbs, did commuting become a recognized research topic. In this century, the fifties saw a proliferation of studies based on traffic flows, management records, and special surveys; and the Federal Government measured intercounty commuting in a national sample survey (*15*). But, as Schnore points out, until 1960 "the United States census—long used as a model by other nations—[was] one of the few in the Western world which [had] never collected information on the places of work of employed members of the labor force as part of its full-scale operations" (*8*).[2] By 1960, a sufficient demand for commuting data existed that the Census of Population included questions on place of employment. Although these questions were repeated in 1970, neither census inquired about distance traveled.

Most commuting research appearing since 1960, whether based on the 1960 and 1970 Bureau of the Census publications, *Journey to Work* (*13*, *14*) or on other sources, has been confined to metropolitan areas. A bulletin based on the 1975 Annual Housing Survey (AHS) contains general commuting information for both metro and nonmetro populations, but it neither examines migration and commuting nor uses current metro boundaries (*10*).

No national study of the intercounty commuting patterns of migrants and nonmigrants living in nonmetro areas had been published prior to this study, which was conducted cooperatively by the U.S. Department of Agriculture (USDA) and the University of Georgia (*3*). Interest in the nonmetro aspects of commuting resulted from the substantial inmovement of people to nonmetro communities in the seventies after decades of net outmovement, growing questions as to the impact of energy costs and supply on settlement patterns, and earlier research findings on the characteristics of metro/nonmetro migrants. Data from the March 1975 Current Population Survey indicated that metro/nonmetro migrants did not have a negative impact on the nonmetro population as some people had predicted. A large number of migrants were in white collar occupations and industries, and their average income was not less than that of the total nonmetro population. The income of metro/nonmetro migrants was similar to that of persons moving in the opposite direction (*2*).

These issues and findings raised questions about similarities and differences among the migrant and nonmigrant groups that had not hitherto been addressed. These questions involved the characteristics of nonmetro commuters, the association between migration and commuting,

*Revised version of paper prepared for the annual meeting of the Population Association of America, April 26-28, 1979, Philadelphia. The paper is based on research conducted under Agreement No. 12-17-09-8-1663, between ESCS and the Institute for Behavioral Research (IBR), University of Georgia. The assistance of Susan S. Carley, Sam T. Davis, III, and Eva J. Miller of the IBR in the development of materials for the paper is gratefully acknowledged.

†The authors are demographers in the Economic Development Division, ESCS.

[1] Italicized numbers in parentheses refer to items in the references at the end of this article.

[2] Schnore's article contains an excellent bibliography of both published and unpublished works before 1960.

With one exception, income was directly and substantially related to rate of commuting among all household heads; the highest rates occurred among those with the highest incomes.

and comparative distances traveled by metro and nonmetro people. A key issue was the extent to which the recent nonmetro population growth resulting from metro/nonmetro migration is linked to commuting to jobs in metro areas.

The 1975 AHS, with its travel-to-work supplement containing information on previous and current places of residence and work for household heads, provides a data base for such investigation.

In our study, *commuters* are defined as household heads who worked in different counties from those in which they lived at the time they were surveyed;[3] *migrants* lived in different counties in 1975 from those in which they had lived 5 years earlier; *household heads* were designated by survey respondents, except that married women were not reported as household heads if they were living with their husbands. The data, based on special AHS tabulations, reflect metro designations through 1975. Thus, they reflect nonmetro and metro commuting more accurately than other published AHS data, which were based on older metro boundaries (*10*).[4] No data were available by migration *and* commuting status for persons who were not household heads.

GENERAL COMMUTING PATTERNS

About 22 percent of all employed U.S. household heads worked in different counties from those in which they lived in 1975 (table 1). The rate of commuting for household heads was somewhat higher than that for all employed people in 1975, which was about 17 percent (*10*), and it was considerably higher than the rate for other household members, which was about 10 percent.

Commuting rates among household heads varied by demographic and social characteristics (table 1). Whites and minorities other than blacks had rates higher than that for blacks.[5] Commuting was far more prevalent among men than women. Household heads living in the South tended to commute slightly more than those in the rest of the country.

Commuting tends to increase until ages 25-34, presumably as jobs become full time and of career nature, and begins to recede with age group 45-54. The pattern by age may be partly associated with cohort differences in propensity to commute, associated with the recency of high commuting rates (intercounty commuting has increased since it was first measured in 1960), but also reflects shifts to secondary types of local work after retirement from a career job. The lower rate of commuting among late middle-aged (55-64) and older workers (65 and older) particularly characterizes nonmetro areas. The greater increase in commuting in nonmetro areas than in metro areas since 1960 probably affects younger workers most. The higher average age of noncommuting farmers—who comprise a greater proportion of workers in nonmetro areas—also contributes to the pattern.

The relationship of commuting to educational attainment was mixed. Persons with 4 years of high school or 4 or more years of college had somewhat higher rates than persons with less education; however, differences were minor. With one exception, income was directly and substantially related to rate of commuting among all household heads; the highest rates occurred among those with the highest incomes. Thus, commuting seems to be rewarded. However, the pattern may also reflect the greater ability of higher income people to live where they wish. There is no way of distinguishing between the two causes.

COMMUTING BY METRO STATUS

A somewhat higher proportion of metro than nonmetro household heads crossed a county line on the trip to work (22.7 percent versus 19.5 percent). This difference is partly influenced by the fact that metro counties are generally smaller than nonmetro counties (mean diameters are about 28 and 32 miles, respectively). Thus, a trip of a given length is more likely to become intercounty in a metro setting. Com-

[3] We recognize that, in addition to the comparative availability of employment, such geographic features as size, shape, and topography of counties are important determinants of commuting patterns. Intercounty commuting, by definition, always occurs in commuting between nonmetro and metro areas.

[4] Information on the reliability of AHS estimates and definitions of terms can be found in recent publications of the Bureau of the Census on the journey to work in selected metro areas and in the AHS *per se* (*10, 11, 12*).

[5] Tests of significance were made at the 2.0- and 1.6-standard error levels, following procedures recommended by the Bureau of the Census for the AHS. In comparative statements, the word "nominally" is used if the difference was statistically significant at the 1.6, but not at the 2.0, level.

Table 1—Rates of intercounty commuting by employed household heads, by residence, mobility status, and selected characteristics, 1975

Characteristic	Employed household heads	Residence in 1975		Mobility status, 1970-75	
		Metro	Nonmetro	Metro/ nonmetro migrants	Nonmetro/ metro migrants
	Thousands				
Number of heads	43,486	32,263	11,222	1,513	1,392
	Percent				
Total, 18 years and over	21.9	22.7	19.5	26.6	19.3
Whites	22.2	23.2	19.4	26.2	19.4
Blacks	18.2	17.6	21.0	*	19.0
Others	24.6	24.8	23.1	*	*
Males	23.3	24.2	20.8	27.9	20.6
Females	14.4	15.2	11.3	15.0	13.8
South	23.5	23.6	23.4	31.9	21.3
North and West	21.1	22.3	16.9	23.4	18.0
Age (years):					
18-19	13.8	10.7	20.2	*	*
20-24	16.9	16.6	17.8	14.0	9.8
25-34	24.6	25.0	23.6	27.1	23.8
35-44	24.1	24.9	21.6	28.1	21.7
45-54	22.2	23.2	19.2	34.0	17.5
55-64	19.0	20.2	15.8	34.9	*
65 and over	13.0	16.4	6.0	*	*
Education (years):					
Elementary	20.0	20.1	19.8	32.6	*
High school, 1-3	20.6	21.3	19.3	27.4	20.9
4	22.8	23.2	21.9	32.1	19.5
College, 1-3	20.4	20.9	18.1	25.6	19.4
4	23.9	26.0	15.1	18.8	19.8
5 or more	22.5	24.4	13.6	18.7	19.5
Income (dollars):[1]	23.3	24.2	20.8	28.7	23.0
Under 3,000	15.5	16.1	14.8	*	*
3,000-4,999	14.7	14.1	15.6	*	*
5,000-6,999	17.6	18.9	15.7	16.4	13.3
7,000-9,999	18.9	18.0	20.6	22.2	10.8
10,000-14,999	21.7	21.7	21.7	29.0	24.8
15,000-24,999	26.1	26.6	24.4	34.4	27.7
25,000 and over	27.2	29.1	17.4	34.1	29.3

* Base less than 75,000.

[1] Restricted to household heads with families with incomes in 1975.

Note: "Migrants" lived in different counties in 1975 from those in which they had lived in 1970. "Metro" and "nonmetro" definitions reflect metro designations through 1975. "Commuters" lived and worked in different counties at the time of the 1975 Annual Housing Survey.

Source: Special tabulations made by the U.S. Bureau of the Census from the 1975 Annual Housing Survey and the Travel to Work Supplement. Household heads for whom commuter status was not reported were omitted. All numbers were independently rounded.

A higher education was positively associated with commuting in metro areas, but education was negatively associated with commuting in nonmetro areas.

muting rates were not higher in metro areas for blacks, nor for residents of the South. Young household heads (those under 25 years) in nonmetro areas commuted more than their counterparts in the metro areas, but for all other age groups, intercounty commuting was more common in metro areas.

A higher education was positively associated with commuting in metro areas, but education was negatively associated with commuting in nonmetro areas. A fourth of all employed household heads who were college graduates were commuters in metro areas, but only a seventh commuted in nonmetro areas. This may be the most important difference between metro and nonmetro areas in the socioeconomic context of workers commuting.

Nonmetro heads with moderate to above-average incomes commuted more than those with low incomes (see figure). This seems logical, as the payoff from low-income jobs does not often tempt people to incur the cost of commuting. However, commuting rates for nonmetro heads with the highest incomes were lower than those for some heads with less income. The highest income category includes many successful farmers and businessmen who work in their own communities. Despite the lower commuting rate of the highest nonmetro income group, commuting of nonmetro household heads to metro jobs yields average income levels above those generally obtainable in nonmetro work. Thus, commuting to metro work helps to raise income levels of nonmetro communities. No such complementary benefit to metro areas occurs when workers commute from metro residences to nonmetro employment.

COMMUTING AMONG MIGRANTS

In both metro and nonmetro areas, migrants had higher rates of commuting than nonmigrants. Nearly a third of those household heads who had moved from one county to another between 1970 and 1975 made an intercounty journey to work in 1975, compared with only a fifth of nonmigrants (table 2). Nonmigrants in the nonmetro population had the lowest intercounty commuting rates (18 percent), and persons who had migrated from one metro county to another had the highest (37 percent). Members of the latter group may have moved within a multicounty metro area without changing jobs.

Of those metro-nonmetro migrants who were commuters, about a third went to another nonmetro county for work (table 3). The rest, comprising 17 percent of all metro/nonmetro migrant heads, commuted to a metro area for employment. This percentage clearly exceeds that of 7 percent for all other nonmetro heads. A higher rate of metro commuting was expected among the recent migrants into nonmetro areas, as some had moved to such areas for residential purposes only. Furthermore, at the time of survey, others might not yet have found a suitable job closer to their new homes.

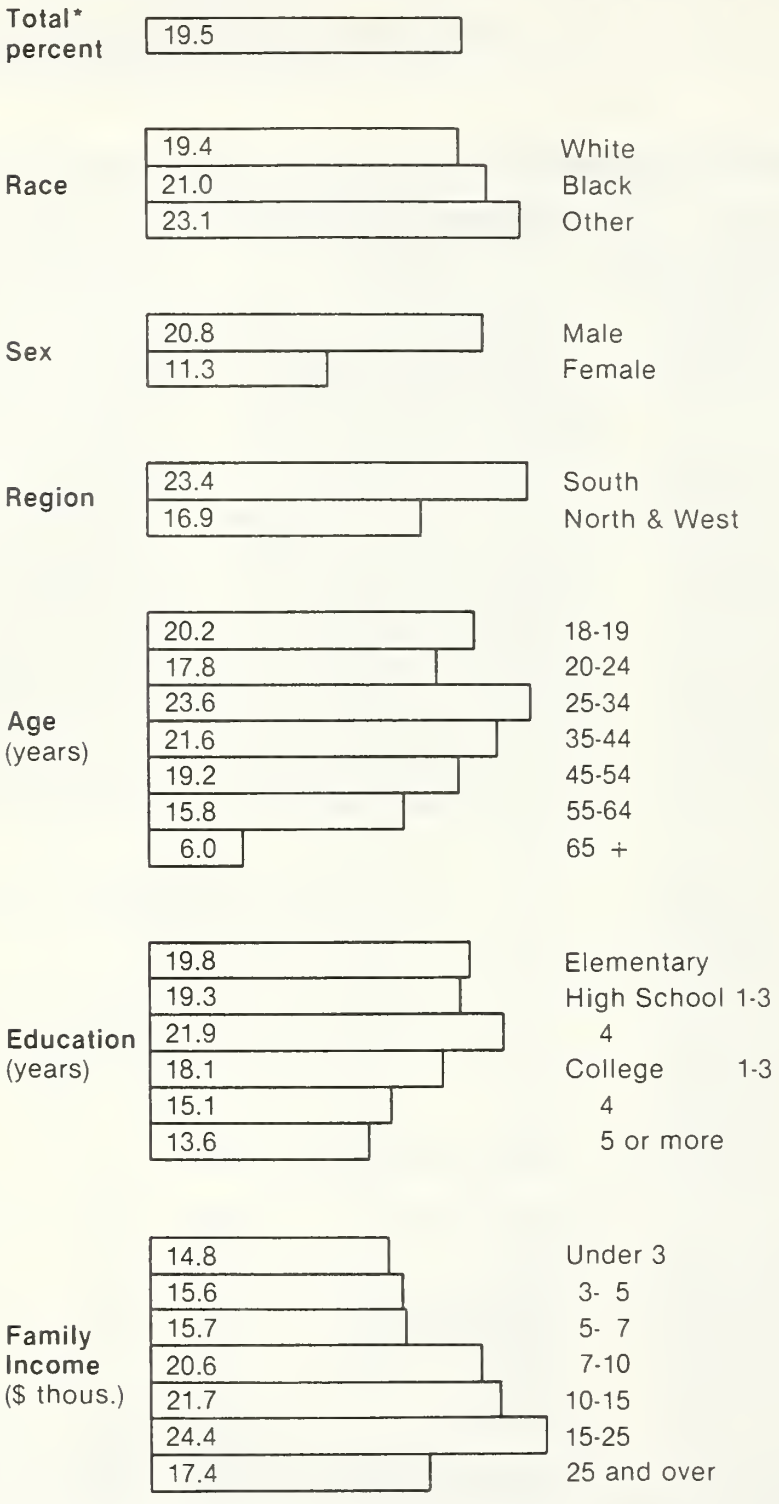
More significant, however, is the fact that five of every six nonmetro newcomers—an overwhelming majority—did not depend on metro

Table 2—Intercounty commuting status of employed household heads, 1975

Residence and mobility status	Total[1]	Noncommuter	Commuter	Commuting rate
	Thousands			*Percent*
Employed household heads reporting commuter status	43,486	33,980	9,506	21.9
Nonmigrant, 1970-75	33,689	27,270	6,418	19.1
Migrant, 1970-75	9,797	6,709	3,088	31.5
Nonmetro, 1975	11,222	9,030	2,192	19.5
Nonmigrant, 1970-75	8,566	7,041	1,525	17.8
Nonmetro/nonmetro, 1970-75	1,143	878	265	23.2
Metro/nonmetro, 1970-75	1,513	1,111	402	26.6
Metro, 1975	32,263	24,949	7,314	22.7
Nonmigrant, 1970-75	25,124	20,229	4,895	19.5
Metro/metro, 1970-75	5,747	3,597	2,150	37.4
Nonmetro/metro, 1970-75	1,392	1,123	269	19.3

[1] Excludes household heads not reporting commuter status.

Rate of Intercounty Commuting, Employed Nonmetro Household Heads, by Selected Characteristics, 1975



*18 years and older. Number of heads, 11,222,000.

Source: USDA-UGA internal migration projects. Based on 1975 Annual Housing Survey.

The pattern suggests that, although commuting occurs at all educational levels, it is the more successful people among metro-nonmetro migrants of low-to-average schooling who are most attracted to inter-county job commuting.

Table 3—Location of employment for commuters, by migrant status

Residence and mobility status	Commuters to—		Percentage of total[1]		Percentage of commuters[1]	
	Metro	Nonmetro	Metro	Nonmetro	Metro	Nonmetro
	---Thousands---		*---Percent---*			
Employed household heads reporting commuter status[2]	7,619	1,889	17.5	4.3	80.1	19.9
Nonmigrant, 1970-75	5,072	1,346	15.1	4.0	79.0	21.0
Migrant, 1970-75	2,547	543	26.0	5.5	82.5	17.6
Nonmetro, 1975	973	1,219	8.7	10.9	44.3	55.6
Nonmigrant, 1970-75	658	864	7.7	10.1	43.2	56.7
Nonmetro/nonmetro, 1970-75	51	214	4.5	18.7*	19.2	80.8*
Metro/nonmetro, 1970-75	262	141	17.3*	9.3	65.2*	35.1
Metro, 1975	6,646	668	20.6	2.1	90.9	9.2
Nonmigrant, 1970-75	4,414	482	17.6	1.9	90.2	9.8
Metro/metro, 1970-75	2,044	107	35.6*	1.9	95.1*	5.0
Nonmetro/metro, 1970-75	190	81	13.6	5.8*	70.6	30.1*

[1]The base data are in table 2.

[2]Excludes household heads not reporting commuter status.

Note: Underlined figures indicate interresidential commuting.
* = commuting to type of area of origin.

employment for their income. Therefore, their move away from the metro area generally was more than just a residential relocation, and more than just exurban sprawl. It involved severing direct economic ties with the metropolis.

Commuting rates among metro/nonmetro migrant heads surpassed those of people who had moved in the other direction, except among college graduates. The relationship between age and rate of commuting among metro/nonmetro migrant heads was direct rather than inverse, in contrast to that in the general population 25 years old and over. The older metro/nonmetro migrants had the highest rates. The commuting rates of metro/nonmetro migrants generally fell as education increased, but rose as income increased. This pattern is unusual in social data; education normally correlates positively with income. The pattern suggests that, although commuting occurs at all educational levels, it is the more successful people among metro/nonmetro migrants of low-to-average schooling who are most attracted to intercounty job commuting. Many operatives and craftsmen, for example, are in this group.

LOCATION OF EMPLOYMENT FOR INTERCOUNTY COMMUTERS

Several authors have attributed the higher prevalence of commuting among migrants to their remaining in jobs they had before moving (*4*, *6*, *9*). Unfortunately, we cannot address this issue directly, as the AHS sample included no questions on place of work before migration or at any previous date.

It is possible, however, to measure the differences in interresidential commuting among migrants and nonmigrants and to determine the degree to which migrants continued to work in the types of areas from which they had migrated. *Interresidential commuting* is defined as living in an area whose metro or nonmetro status is different from that of the area of employment.

Such commuting was higher for migrants than for nonmigrants among both metro and nonmetro

residents. This was true whether the proportions of those working in metro and nonmetro locations were based on overall totals or on the number of commuters in each migrant category. Of the metro/nonmetro migrants who commuted, 65 percent worked in metro areas (table 3).

Only 30 percent of household heads who had moved from nonmetro to metro areas commuted back to nonmetro jobs. However, this is several times higher than the percentage of other metro household heads who had job links to rural and small town areas.

INCOME OF COMMUTERS AND NONCOMMUTERS

We have already indicated the generally positive relationship between income and rates of intercounty commuting for employment. For household heads, median family income was $17,310 for commuters and $14,907 for noncommuters in 1975. The literature is inconclusive as to whether people of higher income status live where they wish because they can afford a longer trip to work or if they commute to another county to maximize earnings (*17*). Suitability of housing at the price a family can afford, preferences as to size of community, considerations of relative safety, availability of educational facilities, and many other factors determine residential choice. These factors are associated with intercounty commuting for employment, but we do not have the data to explore their significance here.

Except for household heads who had moved between two nonmetro areas, commuters in each residence and mobility group had significantly higher median incomes than did the noncommuters (table 4). In general, AHS data for employed household heads showed similar relationships between income, residence, and mobility, as reported in other research (*2*). Whether they were commuters or noncommuters, long-term metro residents had the highest incomes and long-term nonmetro residents had the lowest. Household heads moving between metro and nonmetro areas were in an intermediate position.

AHS data provide additional evidence that metro/nonmetro migrants did not have a negative impact on the income of the nonmetro population. The median income of metro/nonmetro migrants was as high or higher than that of other groups of nonmetro household heads, both for commuters and noncommuters.

Among intercounty commuters, male household heads who worked in different metro counties from those in which they lived had the highest median family incomes (table 5). They were largely suburban commuters to central cities, although our data on metro residents are not specific as to location of employment within metro areas. Their incomes were substantially higher than those of metro residents who commuted to nonmetro locations. Among nonmetro commuters, those

Table 4—Median family income, by mobility status and residence

Residence and mobility status	Median family income, 1975		
	Total	Commuter	Non-commuter
	Dollars		
Employed household heads reporting commuter status[1]	15,495	17,310	14,907
Nonmigrant, 1970-75	15,648	17,241	15,181
Migrant, 1970-75	14,926	17,459	13,983
Nonmetro, 1975	13,076	13,685	12,907
Nonmigrant, 1970-75	13,094	13,500	12,992
Nonmetro/nonmetro, 1970-75	12,278	12,808	12,093
Metro/nonmetro, 1970-75	13,645	15,248	13,020
Metro, 1975	16,736	18,523	16,088
Nonmigrant, 1970-75	16,880	18,559	16,384
Metro/metro, 1970-75	16,665	18,686	15,017
Nonmetro/metro, 1970-75	14,379	16,667	13,790

[1]Household heads with families who had incomes in 1975, rather than all employed heads of household.

The median time traveled from home to work by all houshold heads working away from home at a fixed workplace was 21 minutes . . ., and the median distance was 7 miles. . . . Nonmetro heads required a third less time, and—contrary to what we think may be the popular belief—traveled a 40-percent shorter median distance than did metro heads.

Table 5—Family income for male intercounty commuters

Location of residence and place of work	Number	Median income, 1975	Standard error of income
	Thousands	*—Dollars—*	
Intercounty commuters	7,906	17,779	171
Residence, metro	5,987	19,019	189
Place of work, metro	5,438	19,201	196
Place of work, nonmetro	549	16,856	730
Residence, nonmetro	1,919	13,943	228
Place of work, metro	870	14,931	519
Central city	365	14,421	535
Ring	505	15,500	648
Place of work, nonmetro	1,048	13,189	297

who worked in metro areas had higher median incomes than those who commuted to other nonmetro counties. The incomes of those working in ring locations appear higher than those of the group who commuted to the central cities; however, because of the small number involved, the difference is not statistically significant.

The same general patterns of income differences were observed among white male metro/nonmetro migrants who commuted to other counties for employment (table 6). Those working in metro counties had the highest incomes, and the difference between those in ring and central cities was not statistically significant. Those commuting to nonmetro counties had the lowest incomes. For nonmetro/metro migrants, no real income differences existed between those commuting to other metro areas and to nonmetro locations.

In general, interresidential commuting appears to have raised the overall income of nonmetro residents. This was particularly true for those who had moved from metro areas into nonmetro communities since 1970. Indeed, the data suggest that migrants to nonmetro communities accepted a significant income reduction, on the average, by electing not to commute or by locating beyond the metro commuting range.

JOURNEY TO WORK

Despite the 1974 price increases in gasoline, the prevalent mode of transportation to work for employed household heads in 1975 was the automobile. A majority drove alone, whether migrants or nonmigrants, commuters or noncommuters. No real differences existed, by residence of household head or by mobility status within each population, in the proportions who drove alone. About 70 percent of household heads in all these classes drove to work alone (table 7). Commuters were somewhat more likely to drive with others (table 8)—probably because of the greater average distance and cost of intercounty trips. Commuters also used public transportation more than noncommuters. More noncommuters walked, rode bicycles or motorcycles, or used other means to reach their places of employment.

A higher proportion of nonmetro commuters traveled in automobiles with other people and a higher proportion of metro commuters used public transportation. This represented the major difference in mode of transportation between the two groups.

The median time traveled from home to work by all household heads working away from home at a fixed workplace was 21 minutes (table 9), and the median distance was 7 miles (table 10). Nonmetro heads required a third less time, and—contrary to what we think may be the popular belief—traveled a 40-percent shorter median distance than did metro heads. The nonmetropolitan population is a mixture of people who do not have far to go to work (such as those living in small employment centers and most farmers) and those nonfarm people who live in the open country or small villages and who depend on commuting for employment. Thus, a relatively high proportion of nonmetro workers are at the two extremes of the distance scale, and a wide difference in distance traveled occurs between intercounty commuters and noncommuters. In nonmetro areas, a fourth of all household heads worked either at home or less than 1 mile from their work, whereas in metro areas only a tenth did so (table 8). However, in nonmetro areas, about 1 in every 13

Table 6—Family income for white male migrants

Commuter status and place of work	Metro/nonmetro migrants			Nonmetro/metro migrants		
	Number	Median income, 1975	Standard error of income	Number	Median income, 1975	Standard error of income
	Thousands	*—Dollars—*		*—Thousands—*	*—Dollars—*	
Employed[1]	1,330	13,965	303	1,041	14,929	502
Noncommuter	828	13,466	336	711	14,136	415
Commuter	336	15,560	826	208	17,580	943
Place of work:						
Metro	225	16,702	968	148	17,676	1,036
Central city	100	16,184	1,585	N.A.	N.A.	N.A.
Ring	123	17,090	1,220	N.A.	N.A.	N.A.
Nonmetro	110	13,750	938	61	[2]17,273	2,130

N.A. = not available.

[1] Total includes migrants for whom commuter status was not available.

[2] Base less than 75,000.

Table 7—Household heads driving to work alone, 1975

Residence and mobility status	Total	Intercounty commuter	Non-commuter
	Percent		
Employed household heads reporting commuter status[1]	70.2	63.7	72.1
Nonmigrant, 1970-75	70.5	62.5	72.4
Migrant, 1970-75	69.3	66.1	70.8
Nonmetro, 1975	70.6	63.3	72.6
Nonmigrant, 1970-75	70.3	60.7	72.7
Nonmetro/nonmetro, 1970-75	71.5	68.9	72.3
Metro/nonmetro, 1970-75	71.2	69.7	71.8
Metro, 1975	70.1	63.8	71.9
Nonmigrant, 1970-75	70.5	63.1	72.3
Metro/metro, 1970-75	68.2	65.1	70.1
Nonmetro/metro, 1970-75	70.0	65.7	71.1

[1] Excludes household heads who did not report commuter status, who worked at home, or who had no fixed place of work.

Table 8—Mode of transportation, time, and distance to work for employed household heads, by commuter status, residence, and mobility status, 1975

Characteristic	Employed household heads		Residence in 1975				Mobility status, 1970-75			
			Metro		Nonmetro		Metro/nonmetro migrants		Nonmetro/metro migrants	
	Commuter	Non-commuter	Commuter	Non-commuter	Commuter	Non-commuter	Commuter	Non-commuter	Commuter	Non-commuter
	Thousands									
Household heads	9,506	33,980	7,314	24,949	2,192	9,030	402	1,111	269	1,123
	Percent									
Mode of transportation:										
Auto, alone	63.7	68.9	63.8	70.2	63.3	65.4	69.7	67.6	65.6	70.1
Auto, with others	24.6	15.5	21.7	15.2	34.4	16.2	27.8	16.5	23.2	17.6
Public transport	10.5	4.6	13.4	6.1	.8	.5	.8	.5	8.5	3.4
Walks only	.3	5.3	.2	4.8	.7	6.6	.8	6.9	1.5	5.9
Other means	.9	1.2	.9	1.2	.7	1.4	1.0	2.6	1.1	1.6
Works at home	.0	4.4	.0	2.4	.0	9.9	.0	5.9	.0	1.5
Time, home to work:[1]										
Not working at home	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 15 minutes	8.1	45.1	7.4	39.2	10.4	62.9	7.5	61.7	11.7	48.3
15-29 minutes	28.1	37.1	29.0	40.2	25.0	28.1	24.8	30.0	31.7	37.0
30-44 minutes	30.0	12.9	30.4	14.9	28.5	7.0	28.3	6.5	27.9	11.6
45-59 minutes	15.6	3.1	15.7	3.8	15.5	1.2	17.5	1.1	14.3	2.4
60 and over minutes	18.2	1.6	17.5	1.8	20.6	.8	22.0	.7	14.3	.8
Distance, home to work:[1]										
Not working at home	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Under 1 mile	1.0	13.4	.8	10.4	1.9	22.6	1.5	19.3	1.5	13.4
1-4 miles	7.4	8.7	7.4	37.1	7.4	43.4	4.3	43.5	7.9	40.4
5-9 miles	14.7	22.4	16.3	24.3	9.3	16.5	9.4	19.1	14.7	22.3
10-19 miles	32.2	19.6	34.8	21.8	23.4	13.1	20.0	13.7	31.3	18.4
20-29 miles	21.9	4.5	21.4	4.9	23.5	3.4	25.3	3.0	20.7	4.5
30 and over miles	22.8	1.4	19.3	1.5	34.4	1.1	39.5	1.4	23.8	1.0

[1] Excludes those working at home or with no fixed place of work.

Source: Special tabulations made by the U.S. Bureau of the Census from the 1975 Annual Housing Survey and the Travel to Work Supplement. Household heads for whom commuter status was not reported were omitted. All numbers were independently rounded.

Table 9—Median time from home to work

Residence and mobility status	Total	Intercounty commuter	Non-commuter
	Minutes		
Employed household heads reporting commuter status[1]	20.7	36.9	17.0
Nonmetro, 1975	14.5	37.7	11.9
Nonmigrant, 1970-75	14.3	37.9	12.0
Nonmetro/nonmetro, 1970-75	14.0	34.6	11.4
Metro/nonmetro, 1970-75	16.8	39.4	12.2
Metro, 1975	22.2	36.7	19.0
Nonmigrant, 1970-75	22.0	36.7	19.4
Metro/metro, 1970-75	24.0	37.0	18.2
Nonmetro/metro, 1970-75	18.7	33.6	15.7

[1] Excludes household heads who did not report commuter status, who worked at home, or who had no fixed place of work.

Table 10—Median distance from home to work

Residence and mobility status	Total	Intercounty commuter	Non-commuter
	Miles		
Employed household heads reporting commuter status[1]	6.9	18.3	4.8
Nonmetro, 1975	4.6	23.4	3.5
Nonmigrant, 1970-75	4.5	23.3	3.5
Nonmetro/nonmetro, 1970-75	4.3	19.9	3.3
Metro/nonmetro, 1970-75	5.9	25.9	3.8
Metro, 1975	7.6	17.3	5.5
Nonmigrant, 1970-75	7.3	16.9	5.6
Metro/metro, 1970-75	9.3	18.2	5.7
Nonmetro/metro, 1970-75	6.2	18.3	4.6

[1] Excludes household heads who did not report commuter status, who worked at home, or who had no fixed place of work.

household heads commuted 30 miles or more each way, compared with 1 in every 18 of metro heads.

The differences among nonmetro residents are more obvious when one compares intercounty commuters with noncommuters. Of those nonmetro household heads who worked within their own counties, the vast majority (three-fourths) worked within 5 miles of home. However, when they worked in other counties, nearly three-fifths traveled 20 miles or more each way. Nonmetro household heads who commuted traveled a median distance 6.7 times that of noncommuters, whereas metro commuters traveled a median distance only 3.1 times that of noncommuters, as can be computed from table 10.

The time spent in intercounty commuting was nearly the same for both metro and nonmetro household heads (table 9), because the greater distance traveled by rural and small-town commuters is largely offset by faster travel. However, among noncommuters it took the metro group longer to go to work (19 minutes median) than those in nonmetro counties (12 minutes) (table 9). This difference occurs not because of slower travel, but because metro people live farther away from jobs in their own counties than do people in rural areas and small towns.

Among nonmetro residents, those who have moved from metro areas were not only the most likely to commute to a different county to work, but they were also prone to make the longest trips. About 40 percent of intercounty commuters among this group commuted 30 miles or more each way (table 7). Of all residential groups, this population appears to be the one most likely to

Probably the most striking statistics in this study are on the short median distance to work traveled by nonmetro workers (4.6 miles), even when those working at home are omitted from the computation, and the fact that this distance is well below the median for metro workers (7.6 miles).

be affected adversely by higher prices for gasoline or any recurrence of gasoline shortages. Of all nonmetro employed household heads, 8 percent traveled 30 miles or more each way.

CONCLUSIONS

The data presented here are for 1975, but the patterns they describe are not likely to have changed perceptibly. We can say that about a fifth of employed nonmetro household heads work in counties in which they do not live, and that somewhat less than half of this group commute to metro jobs. Given the fact that more than half the total nonmetro population lives in counties adjoining metro areas, this is a rather low percentage. Nonmetro residents remain overwhelmingly independent of metro labor markets, despite the comparative ease of automotive commuting today.

Only 17 percent of all household heads who had moved into nonmetro communities from metro areas between 1970 and 1975 were still working in metro locations. When renewed population growth in nonmetro areas was first noticed in the early seventies, there was an initial tendency to ascribe it to little more than the residential sprawl of metro workers into the next tier of nonmetro counties. As data on the geography of nonmetro growth became available, it was evident that nearly all areas of the Nation were affected, not just those within commuting distance of metro areas. The data presented here should lay to rest any lingering suspicions that a major portion of the newcomers to nonmetro areas have retained their metro employment.

The journey to work by household heads is dominated by workers who travel by car and drive alone. Interestingly, nonmetro workers who work away from home are somewhat more likely to have carpools than are metro workers (21 versus 17 percent). Yet, it would seem more difficult to arrange for joint use of autos in the dispersed low-density population of rural and small town areas than in large cities and suburbs. Although carpooling may not be as common anywhere as it should be for conservation purposes, nonmetro people evidence a greater willingness to adopt it thus far.

Probably the most striking statistics in this study are on the short median distance to work traveled by nonmetro workers (4.6 miles), even when those working at home are omitted from the computation, and the fact that this distance is well below the median for metro workers (7.6 miles). The difference in mean distances would not be as large, as nonmetro workers are disproportionately found among those traveling lengthy distances as well as short ones. However measured, the mass of nonmetro residents—especially the longer term ones—do not require inordinate amounts of fuel or time to travel to and from their employment, whether in absolute terms or in comparison with metro residents.

Nonmetro residents who rely on intercounty commuting for their employment are an exception, for they have the longest work trips of any residential class, with a median of 24 miles. Gasoline price increases and/or future supply shortages could make people less willing to move into nonmetro counties if they want to retain metro jobs, or could reduce their movement into the rural countryside if they work in nonmetro towns. Such a dispersal trend in counties far removed from metro areas was one of the most characteristic—and unforeseen—aspects of the growth of nonmetro population in the seventies (*1*).

Much intercounty commuting and other long-distance travel to work in rural areas occurs because suitable employment within the home community is lacking. The rapid growth of nonagricultural work in rural areas and small towns in the last 10-15 years has probably eased this problem. However, it has also drawn many people into the nonfarm labor force who previously did not work away from home or who would have moved to a metro area if local work was unavailable.

As we have shown, low-income people commuted less than higher income people. One reason was their lack of access to transportation (*5*, *16*). Low-income rural and small-town people often have neither automobiles nor access to public transportation, or they may have only one vehicle when two are needed if both spouses work. Thus, if they are to work at all, they may have to take jobs in their home communities that are often low-paying. Improved rural transportation facilities would almost certainly increase the number and proportion of workers who commute beyond their home communities. However, even in metro areas the proportion of employed household heads using public transportation is so low (8 percent) as to suggest that public transportation may not be able to absorb a significant porportion of potential workers or of current automobile riders unless radical changes in facilities, preferences, and relative costs occur.

The AHS data do not answer all our questions concerning job commuting and its relationship to residential status and recent migration. However, they considerably advance our understanding of the issues.

REFERENCES

(1) Beale, Calvin, and Glenn V. Fuguitt. "Demographic Perspectives on Midwestern Population Redistribution." Paper presented at a conference on Issues and Consequences of Population Redistribution in the Midwest, Urbana-Champaign, Ill., Mar. 12-14, 1979.

(2) Bowles, Gladys K. "Contributions of Recent Metro/Nonmetro Migrants to the Nonmetro Population and Labor Force," *Agricultural Economics Research*, Vol. 30, No. 4, Oct. 1978, pp. 15-22.

(3) Bowles, Gladys K., and others "Commuting Patterns of Nonmetro Household Heads, 1975." Cooperative report of the U.S. Department of Agriculture and the University of Georgia, 1980.

(4) Goldstein, Sidney, and Kurt Mayer. "Migration and the Journey to Work," *Social Forces*, Vol. 42, May 1964, pp. 472-481.

(5) Kain, John. "Journey to Work and Residential Location," Gerald Carrothers (ed.), *Regional Science Association Papers*, Vol. 9, Japan International Academic Printing Co., Ltd., Tokyo, 1962.

(6) Liepmann, Kate K. *The Journey to Work: Its Significance for Industrial and Community Life*. Oxford University Press, New York, 1944.

(7) New York State. *Census of the State of New York for 1865*. Prepared by Franklin B. Hough, Superintendent of the Census. Printed by Charles Van Benthuysen and Sons, Albany, N.Y., 1867.

(8) Schnore, Leo F. "Three Sources of Data on Commuting: Problems and Possibilities," *Journal of the American Statistical Association*, Vol. 55, Mar. 1960, pp. 8-22.

(9) Sheldon, H. D., and S. A. Hoermann. "Metropolitan Structure and Commutation," *Demography*, Mar. 1965, pp. 186-193.

(10) *U.S. Bureau of the Census.* "The Journey to Work in the United States: 1975," *Current Population Reports*, Series P-23, No. 99, 1979.

(11) _____. "Selected Characteristics of Travel to Work in 20 Metropolitan Areas: 1976." *Current Population Reports*, Series P-23, No. 72, 1978.

(12) _____. "Annual Housing Survey: 1975. United States and Regions, Part A, General Housing Characteristics. *Current Housing Reports*, Series H-150-75A, (and related data tapes), 1977.

(13) _____. *Journey to Work.* 1970 Census of Population, Series PC (2)-6D, 1973.

(14) _____. *Journey to Work.* 1960 Census of Population, Series PC (2)-6B, 1963.

(15) _____. "County of Work and County of Residence: September 1954," *Current Population Reports*, Series P-20, No. 60, 1955.

(16) Westcott, Diane N. "Employment and Commuting Patterns: A Residential Analysis," *Monthly Labor Review*, Vol. 102, July 1979, pp. 3-9.

(17) Wheeler, J. O. "Occupational Status and Work Trips," *Social Forces*, Vol. 45, June 1967, pp. 508-515.

GOAL CONFLICTS IN RURAL ECONOMIC DEVELOPMENT

By Daniel G. Williams*

In regional economic development planning, achieving one objective often results in achieving less of another; tradeoffs exist among alternatives. Two pairs of area economic objectives are examined—gross regional product versus local employment and local wage bill versus local employment—and tradeoff curves are derived. The tradeoff curve range is greater and, therefore, the conflict situation more interesting between the first pair of objectives—a capital-oriented and a labor-oriented objective—than between the second pair—two labor-oriented goals. As regions become more open, tradeoff schedules shift outward and range and curvature increase, intensifying the need for compromise.

Keywords

Regional goals
Tradeoff curves
Linear programming
Rural development
Economic planning

When community leaders discuss economic development planning, they face a dilemma—namely, that attaining specific goals may improve conditions for some groups in the community and aggravate them for others. For example, the industry mix that will most increase the level of business activity may also leave some of the unskilled workers without jobs. Or, the industry mix that promises the highest wages for local workers may also require inmigration or incommuting of workers with special skills, and thereby exclude residents who lack these skills. Not all regional needs can be achieved simultaneously; therefore, tradeoffs must be made.

Planners are aware of this conflict and economic theory recognizes it. Yet, when implementing policies, community leaders and other planners often overlook possibilities for tradeoffs. Sometimes conflicts are not discussed because people think they will be resolved in the marketplace. Sometimes conflicts are overlooked because it is difficult to quantify the problem, set forth the consequences of alternative development policies, and identify those who will gain or lose from these alternatives. Rural development planners should seek to clarify and quantify the tradeoffs between opposing goals so that well-informed, intelligent political decisions can be made.

Policymakers can both evaluate the most efficient way to reach alternative goals and also identify the economic implications for each special interest group. Tradeoffs and compromises can then be based on this information.

CONFLICT OVER SPECIFIC GOALS

Conflict over development policy is often revealed in terms of conflict over specific goals. For example, in a multicounty area in northwest Arkansas (a region which has grown rapidly in the past 10-15 years), one group of citizens feels there has been sufficient economic development and wants to close the area to newcomers so that changes can be "digested." Another group, primarily representing business and commerce, wants more expansion.

The counties where this conflict has occurred have a somewhat mountainous terrain which, despite a small airport and a two-lane highway, tends to isolate the area. The specific conflict has focused on whether to build a larger airport and an interstate toll road; both projects are expected to spur economic growth in the region.

This example suggests the inevitability of disagreement among groups with disparate goals. It indicates the need—however difficult to accomplish—for cooperation and compromise in setting and achieving development objectives.

Using comprehensive economic models to examine tradeoffs between such specific goals is difficult because the detail required is prohibitive. However, models can be constructed to examine tradeoffs between relatively general goals, such as maximizing output in contrast to maximizing employment.

THE MODEL AND DATA

USDA has conducted research into the tradeoffs between alternative general economic goals in rural regions. The economic development model used, called RDAAP (Rural Development, Activity Analysis, Planning), is a conventional linear programming model. Its structure is briefly described here.[1] Most data

* The author is a regional economist with the Economic Development Division, ESCS.

[1] The mathematical structure and coefficient detail are presented in Daniel G. Williams, "Structural Details of a Linear Programming, Rural Economic Development Planning Model: Northwest Arkansas," Working Paper No. 7907, U.S. Dept. Agr., Econ. Stat. Coop. Serv., Econ. Devt. Div., June 1979.

are from secondary sources, such as the U.S. Census of Population, the U.S. Census of Agriculture, and "work sheets" used by the U.S. Department of Commerce in compiling the 1958 U.S. Input-Output table. The service and manufacturing industries represent those industries commonly found in rural or smaller metropolitan regions.

The study area is a three-county region in northwest Arkansas—Benton, Madison, and Washington counties—identified here as the BMW region. Two of these counties are metropolitan; the third, a rural county, depends on the metropolitan counties for access to jobs, retail and wholesale trade, and urban services.[2]

The model maximizes specified regional objectives, such as the level of gross regional product, subject to the region's economic constraints. These constraints are imposed by the availability of community resources, such as the size and skill level of the local labor force. Access to distant markets is specified so that profits per unit of sales decrease as more distant markets are penetrated and transportation costs increase. Both commuting from the three-county area to work in neighboring counties and commuting from these neighboring counties into the study area are considered in the analysis. The industry mix includes agriculture, construction, manufacturing, services, and government. An input-output matrix is embedded into the linear programming model to incorporate interindustry flows of goods and services. Regional targets for population and income for a 10-year planning period are set and the model is solved for the most efficient way to reach these targets. The version of the model reported here sets a target for population and labor force growth and then indicates the industry mix, use of labor and other resources, and other policy actions needed to accomplish a regional objective such as maximizing gross regional product, employment, or wages paid to workers.

The model is incremental. It takes as given the economic activity of a base-year period and seeks the most efficient way to reach regional goals set in a target year. The time period from 1960 to 1970 was selected so that industry growth under an optimization planning model could be compared with actual industry growth. The model can be applied to many rural-oriented, multicounty, planning regions. The industries included are those likely to locate in rural or smaller metropolitan areas. The agricultural sector of the model, which is regionally specific, was constructed from U.S. Census of Agriculture secondary data.[3] The model is intended for planning rather than for forecasting or projecting.

TRADEOFFS AMONG REGIONAL ECONOMIC GOALS

In this article, I report only a portion of the total U.S. Department of Agriculture (USDA) research project and explore tradeoffs among general economic goals. I examine these goals in pairs and report results for two of these pairs. First, I compare tradeoffs between gross regional product and regional (local) employment and, next, tradeoffs between the local wage bill and local employment. A significant finding is that more local jobs can be created—under the assumption of a given (fixed) level of regional resource availability, technology, and access to markets—if a region is willing to reduce the level of aggregate production of goods and services (GRP). This finding is what one might expect. Attracting industries that provide the greatest volume of final sales may not provide employment for some unskilled local residents. Attracting industries that use all the available local labor may yield less output per worker so that total output is reduced.

The theory of a tradeoff curve is standard in economics. What is new is that we can use linear programming to display an empirically determined tradeoff curve to help local planners reach compromises among general goals. Linear programming shows what combinations of goals are feasible and need to be considered; it shows what combinations are not feasible and need not be examined further. It shows how a tradeoff curve shifts as resource availabilities, technology, and access to markets change. It identifies special interest groups affected by

[2] Benton and Washington counties were declared a single SMSA after the 1970 U.S. Census of Population. According to this designation, the area is metropolitan and not rural. However, as a recently emerged and relatively small SMSA, it illustrates how an area evolves from a relatively rural to an urban status.

[3] This process is explained in Daniel G. Williams, "Agricultural Census Data as a Source of Linear Programming Vectors," *Agricultural Economics Research*, Vol. 30, No. 2, Apr. 1978, pp. 34-37.

The theory of a tradeoff curve is standard in economics. What is new is that we can use linear programming to display an empirically determined tradeoff curve to help local planners reach compromises among general goals.

local economic development policies. It shows that to escape tradeoffs (at a given level of regional resource availabilities and export possibilities), one can focus on regional policies that relax such regional constraints so that more of each objective can be attained; however, this solution implies a new tradeoff problem at a higher level.

Alternative Regional Goals

Gross regional product is defined as the market value of final goods and services produced in the region: consumption + investment + government + exports - imports. In this study, both consumption and government spending were targeted at levels corresponding to actual 1970 levels for the BMW region. Hence, a rise in gross regional product depends on increasing the level of local investment plus the net regional trade surplus.

The regional (local) aggregate wage bill is defined as the sum of all wages earned in the region. This sum excludes wages from residents who commute out of the region and workers who commute into the region (hence the term "local"). Labor incommuting limits (constraints) in the model are based on commuting patterns reported in the 1960 census; incommuting levels must be at or below some upper level. Labor outcommuting is not similarly constrained.

Regional (local) employment is defined as the sum of all labor employed in the region, except the employment of labor incommuters and of outcommuting BMW region residents.

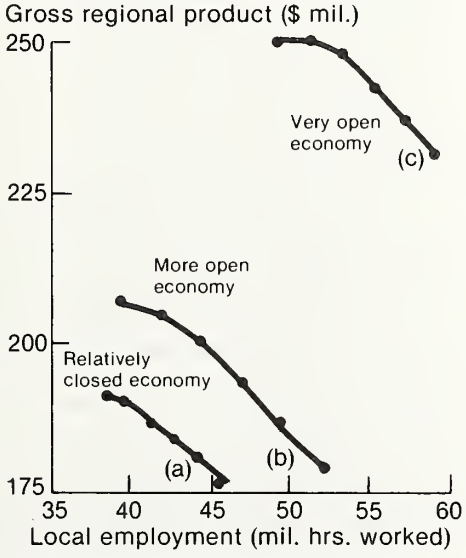
Gross Regional Product Versus Local Employment

Figure 1 presents the tradeoff curves for gross regional product and local employment. The method used is that of parametric linear programming; gross regional product is maximized for alternative assumed levels of local employment. For example, one end point of curve (a) represents the maximum possible gross regional product; the other represents maximum local employment. All possibilities on the curve assume a region relatively closed to exports and incommuting. Other possible objectives, such as maximizing the local wage bill, are unconstrained. "Relatively closed" means that exports from the region and labor incommuting to the region were significantly greater than zero but assumed to be at relatively lower levels (than for curves (b) and (c)).

Figure 1

Objective Function Tradeoff Curve, BMW Region, 1960-70

Gross Regional Product vs. Local Employment



With regional balance-of-payments surplus constrained to zero or above.

The transition from curve (a) to (b) to (c) reflects successive assumed increases in the upper limits for export to regional and national markets and for labor incommuting. Such increases simulate an increasingly open regional economy for trade and labor flows to the rest of the country. For each of the three curves, the regional balance-of-payments surplus (that is, net trade flows plus net investments and profits flows) is constrained to be nonnegative to prevent a zero shadow price on regional ("foreign") exchange.

The relative positions of tradeoff curves (a), (b), and (c) in figure 1 show that more open economies, other things being equal, can achieve more of each goal (that is, gross regional product and local employment) simultaneously. To the extent that a region can shift to a higher curve, the two goals can be treated as complements rather than as substitutes. It is when such opportunities are limited that tradeoffs are required.

Curve (c), in an extremely open economy, exhibits more curvature (concave to origin of graph) than do curves (a) or (b), and it has a greater range from one end point to the other. Curve (a), in a relatively closed economy, is represented by an almost straight line and has a relatively limited range. Movement along any of these curves reveals how much one goal can be increased for a unit decrease in the level of the other. For more closed regions (curve (a)), this opportunity cost remains fairly constant and the range for tradeoffs is relatively narrow. For more open regions (curves (b) and (c)), the opportunity cost increases greatly near either end point and the range is relatively wide. The tradeoff curves

suggest the possibility of a conflict of interest between business managers who gain from a high volume of general business activity and workers who gain from an increase in the number of employment opportunities. The range of conflict and the costs of maximizing one goal at the expense of the other both increase as an economy becomes more open.

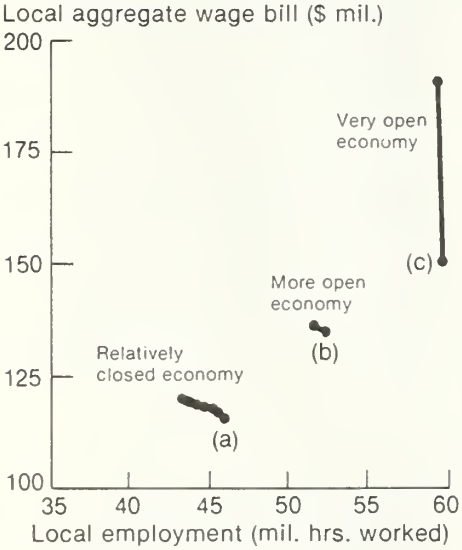
Aggregate Wage Bill Versus Local Employment

Figure 2 shows the tradeoffs between the local aggregate wage bill and local employment. This example demonstrates that not all tradeoff curves representing pairs of goals exhibit textbook shapes. One of the curves in figure 2 reduces almost to a point so that little range of conflict exists. The curve for an extremely open economy indicates that gains in the wage bill can be obtained at virtually no cost in foregone employment. Such information could affect the debate when local interest groups try to influence economic development policy.

Figure 2

Objective Function Tradeoff Curve, BMW Region, 1960-70

Local Aggregate Wage Bill vs. Local Employment



With regional balance-of-payments surplus constrained to zero or above.

Curve (a) for a relatively closed economy shows a limited range of possible tradeoffs. The end point which maximizes the local wage bill accounts neither for wages brought in by outcommuters nor wages taken out by incommuters. That is, local payments to local residents are maximized, even if the result is some unemployment or more commuting. The following tradeoff occurs: As more jobs are created for local people by attracting those industries better utilizing the entire available local labor skills, average hourly wages decrease so substantially that the total wages paid to local people fall in spite of the increased local employment. The mechanism causing this decline is a change in industry mix that eliminates many higher paying jobs and creates more lower paying ones, resulting in underemployment for the most skilled segment of the local labor force.

Curve (b) shows almost no tradeoff at all. Groups who gain from an increase in the number of jobs created by local economic development are likely to agree completely on policy with groups who gain from an increase in the level of aggregate regional wage payments.

Curve (c), for a very open region, while appearing different from curve (b), actually reveals a similar result as both parties to a conflict might readily agree to operate at the point of a maximum wage bill. The slight increase in possible employment (from the point of maximum wage bill to that of maximum local employment) would not compensate for the cost of the associated precipitous drop in the wage bill. That is, the number of local jobs for local people remains about the same throughout the range of curve (c). Maximizing the local wage bill requires an industry mix that employs managerial skills which are incommuted and pays relatively high wages to local employees. To create more jobs—without concern for the local wage bill—requires a change in the industry mix. The new mix does not require the incommuting of managers, resulting in a lower general skill level for the region. Thus, the job-maximizing industry mix pays lower average wages per hour to local residents than does the wage-maximizing industry mix. The more open the economy (curves (b) and (c) in figure 2), the more agreement is likely to occur between interest groups. It is the closed economy (curve (a)) in which a conflict is likely to occur between advocates of higher wage levels and advocates of more job creation. Workers who could have high-wage jobs in high-wage industries would not be inclined to reject those industries (and jobs) and take lower paying jobs to support alternative programs attracting lower-skilled industries to the area, which would provide more jobs for the unemployed.

The method used here can identify situations in which maximizing a single objective may lead to unintended side effects with costly results.

TRADEOFFS AMONG REGIONAL GOALS: AN INTERPRETATION

How can the differing results in figures 1 and 2 be interpreted? In figure 1, the range of tradeoff between output and employment is relatively large, and achieving one goal results in substantial costs in terms of the other. In figure 2, achieving one goal also tends to achieve the other; the curve ranges are fairly short. That is, wage and employment goals can be considered as nearly "joint" objectives.

One interpretation is to consider maximizing gross regional product (or regional balance-of-trade surplus) as an objective more aligned to the interests of capital or management. Both local employment and aggregate wage bill maximizations are then considered more consistent with the interests of labor. Although this interpretation can be understood intuitively, it is also borne out by additional model simulations not presented here. Various capital-oriented objectives tend to yield higher regional private industry profits and higher rates of return on investment capital, but lower local aggregate wage bill totals; the opposite results for various labor-oriented objectives. One would, therefore, expect a capital objective to be costly in terms of a labor objective, whereas two labor objectives (or two capital objectives) might be complementary. Figures 1 and 2 confirm this hypothesis, especially for more open regions (curves (b) and (c)).

Additional pairs of goals were examined. For example, the ranges of tradeoff are substantial for conflict between the interests of labor and those of groups benefiting from a surplus in the region's balance of trade. Similar results occur for the gross regional product maximization versus the local aggregate wage bill.

Obtaining one goal can be costly in terms of foregoing another. There is usually no "free lunch." The method used in this study can identify situations in which considerable conflict is likely and in which agreement and cooperation can be expected. It can identify special interest groups who would benefit from one objective but lose from another.

Tradeoffs are likely to become more important (larger range and more curvature) as a region becomes more open and specialized and as it develops more linkages with other regions. In more open regions, opportunity costs increase substantially near either end of a tradeoff curve.

What do these tradeoff costs tell an area planner? The method used here can identify situations in which maximizing a single objective may lead to unintended side effects with costly results. A sensible planning practice would be to identify which pairs of goals are likely to lead to such conflict and then to choose or implement only those solutions that are efficient (in terms of the highest tradeoff curve attainable), and at a point on the curve representing a reasonable compromise between conflicting interests. Arriving at some "middle" solution is, in fact, what happens when special interest groups bargain politically to shape economic policy. The results obtained here suggest that tradeoff curves can be used to present options to politicians and planning groups and to identify situations involving cooperation rather than conflict. The local political process can then be used for compromise.

RESEARCH REVIEW

FARM AND FOOD POLICY

Don Paarlberg,
University of Nebraska Press,
Lincoln, 1980, 338 pp., $16.50.

*Reviewed by Luther Tweeten**

In describing that animal called the political economy of agriculture, all men are blind. But some men are far more accurate than are others in describing the beast. In recent years, "radical chic" has produced many descriptions by blind men who love the beast (at least, the smaller species of it) but who neither grew up with it nor understood its anatomy. Another set of blind men describes parts of the beast in great detail.

Farm and Food Policy is a comprehensive work by an economic generalist with rare background and skills to perceive, describe, and integrate the parts into a meaningful whole. Professor Paarlberg's work is well timed, well written, and well reasoned. He is willing to criticize giant cooperatives, labor unions, and other sacred cows operating in restraint of trade. The ideology most evident in this book is pragmatism—he isolates real issues and deals with them with common sense, humanitarianism, and sound advice. Paarlberg has presented the most complete and realistic portrait of the political economy of agriculture likely to appear for some time.

The book gets off to a slow start with a familiar theme for those of us who have followed Dr. Paarlberg's speeches and writings for years. His thesis is that farmers, once the most numerous occupational group, have lost not only their political power but also their uniqueness, as farming has become more a business and less a way of life. For a hundred years, farmers had the policy initiative, calling the signals, moving the ball, and putting points on the scoreboard. But farmers lost the ball sometime during the past 15 years and they must learn to play defense. One by one, agriculture is losing its extraordinary advantages: preferred access to land and water, immunity from social legislation, preference as to military service, and lax enforcement of civil rights laws.

He contends that, because farmers have lost control of the agricultural policy agenda, they will find a strategy of cooperation rather than confrontation more successful in confronting their detractors. Confrontation has created issues and escalated minor issues into major ones that have resulted in erosion of farmers' limited political power. If farmers can identify the likely issues for the eighties, farmers and others can weigh the alternatives more carefully and gather information to make wise decisions. Deescalation, common ground, and tradeoffs form sound public policy. Deescalation might mean searching out facts about safety and environment and supporting leaders who respect the facts rather than resorting to name calling. Finding common ground might imply recognizing the advantages of national economic progress in which prospering nonfarm people provide better markets for farm products while prospering farmers provide a bountiful supply of wholesome food. Tradeoffs might involve "sacrificing" the "big-farm bonanza" of current commodity programs in return for nonfarm support of credit policies to assist family farmers. Quarrels within the agricultural establishment ought to be averted. Intramural disagreements between land-grant colleges and the U.S. Department of Agriculture (USDA), for example, are a luxury, once tolerable because agriculture's overall position was strong, but they are no longer affordable, according to Paarlberg.

He outlines three agendas: (1) before 1933, agricultural development, particularly research and education; (2) since 1933, commodity programs, and (3) since the midsixties, issues raised by nonfarmers.

His book contains a brief analysis of the old policy agenda, but is primarily an analysis of the policy agenda for the eighties: price controls, the consumer movement, food regulation, domestic food programs, the environment, occupational safety and health, land and water use, energy, the family farm, minorities, USDA, and international issues.

According to Paarlberg, the agricultural policy course at the typical land-grant college had the big commodity programs as almost its exclusive content, but during the eighties, the topics on the eighties agenda will be taught. The major contribution of this book is the scholarly, but by no means pedantic, treatment of items on the new agenda.

The following vignettes catch some of the flavor:

> Favored treatment for agriculture is not a prize won by political power; it is a gift conferred by an indulgent state (p. 12).
>
> . . . [F]arm organizations are alike in one respect: they all reflect, on balance, the views of those who operate large rather than small farms. . . . No one has yet been able effectively to organize or reflect the felt needs of the small, low-income farmers (p. 45).

*The reviewer is Regents Professor, Department of Agricultural Economics, Oklahoma State University, Stillwater.

> The old advocates of big government programs have come to realize that these programs do not always work and that they are sometimes booby-trapped. The old opponents of these programs generally acknowledge that a greater degree of stability is desirable than is likely to be provided by a completely free market (p. 52).
>
> Abrasive tactics like those used by the American agriculture movement are more likely to hurt than to help (p. 54).
>
> [T]he agricultural establishment, which sometimes seems caught up in a death wish, is apathetic regarding rural development. Either consciously or unknowingly, the agricultural establishment runs the risk of reducing by half its already diminished numbers (p. 224).
>
> The Department of Agriculture is on its way toward becoming, in fact if not in name, a Ministry of Food (p. 242).
>
> "The consumer movement is visibly and favorably related to organized labor" (p. 74) "and many consumer causes were shallow and poorly founded" (p. 77).

As to the plight of farm wage workers, Paarlberg asks: "What might be done? Providing collective bargaining rights . . . seems a reasonable thing despite its dangers" (p. 228).

For environment and other externalities, the shift has been from education to regulation. "We moved from individual to group decision-making, from voluntarism to mandatory change" (p. 82).

The book is not without deficiencies. Some issues on the "new" agenda are already of fading interest, while solutions to some old agenda items are still needed.

Many academics are appalled at the adversary relationship characterizing politics, where extreme positions are taken by warring factions with the intent of compromising to a preferred position. Although not condoning public demonstrations, harassment of public officials, and other tactics of adversary politics, I admit that agricultural interests have used them with success in the past and probably will again in the future. There are times to cooperate with your opponent who has the ball, as called for by Dr. Paarlberg. But continuing his metaphor, I say there are also times to grasp the initiative from misguided opponents who wish to load the agricultural agenda with items neither in the interests of farmers nor of the Nation.

Other specific shortcomings and questionable conclusions include:

1. The discussion of the agricultural creed in chapter 2 contains no mention of Brewster's Agrarian Creed or the Physiocrats.
2. The historic farm policy agenda in chapter 3 mentions research and extension, but does not note the early land policies which gave rise to the family farm structure of today.
3. Paarlberg states that "[People] see the windfall gains that accrued to landowners during the past forty-five years. They bid up the price of land to levels not justified by its present or prospective earnings" (p. 689). I contend current land prices can be justified by prospective earnings.
4. Paarlberg recognizes inflation as an intruder, "not the friend farmers once thought he was," but leaves this basic issue without substantive treatment.
5. He would do well to recognize that because a consumer's income is limited and there are many claims on it, a very real conflict exists among consumers, taxpayers, and farmers, especially in the short run.
6. In discussing the food and nutrition problem, he largely ignores the most severe malnutrition in this country—obesity which results from improper eating (p. 115).
7. "The FAO [Food and Agriculture Organization] says there are 450 million people in the world who lack sufficient food . . . We simply lack the resources that would be necessary to supplement the food supplies of that many people" (p. 282). I have shown that the United States does indeed have the physical capacity to produce sufficient food for the world, but we both agree that it would be most unwise to do so even if we had the will.
8. Paarlberg classifies as a myth the assertion that food aid misses the target groups but later says, "I know of no careful studies of the degree to which food aid is diverted from the intended recipients" (p. 284). Before branding the assertion as myth, we need studies to find out the economic class of those who receive food aid.

THE DEVELOPMENT OF AMERICAN AGRICULTURE:

A HISTORICAL ANALYSIS

Willard W. Cochrane,
University of Minnesota Press,
Minneapolis, 464 pp., $25.00 (cloth),
$10.95 (paper).

*Reviewed by R. J. Hildreth**

The reviewer of a book seldom finds a review framework suggested by the author. Cochrane's last chapter contains a rationale for his historical analysis. He suggests four general uses of historical analysis. The first is the sheer pleasure of knowing and understanding the past. The second is the perspective on current events derived from an understanding of historical processes. Third, analyzing historical description and data series helps us construct rigorous economic models and test theories of economic development. Fourth, decisionmakers in government and business can turn to the past for guidance in their current decisions. I use Cochrane's own rationale for historical analysis as a framework for reviewing his book.

His three major sections include a chronological history of agricultural development, an analysis of the forces of development and structural change, and a conceptual model of agricultural development from 1950 to 1977. Cochrane's chronological history also emphasizes change and development, which gives his account a unity that historical writing sometimes lacks. The section on forces of development and structural change incorporates an analysis of the historical process. Cochrane develops a quantitive conceptual model of agricultural development in the 1950-77 period and uses this model to explore the future.

Although not on the scale of the popular historical works of Bruce Catton or Barbara Tuchman, Cochrane's analysis will delight the reader interested in the historical development of U.S. agriculture. Having lived and worked in Iowa, Texas, and Illinois, I was especially pleased by his historical insights into the agricultural development of these States.

Cochrane's perspective on many current issues is valuable—for example, the structure of agricultural technology, the role of agricultural policy, and the role of international trade. The leaders of the American Agricultural Movement, who attempted to withhold production to raise prices, might find Cochrane's historical analysis illuminating.

Cochrane's conceptual model of the development of U.S. agriculture depends largely on inelastic supply and demand curves. The inelasticity leads to a cannibalism within agriculture; that is, the larger, more progressive farmers swallow up the smaller and less progressive ones. This process leads to a treadmill whereby any increase in product price is bid into the price of the resources, especially land, and profit can seldom be maintained in the long run.

Cochrane properly points out that the foreign component of aggregate demand is highly unstable due to variable and unpredictable growing conditions and changes in foreign trade policies (for example, the January 1980 embargo on wheat and feedgrain sales to the USSR). Although helpful in identifying prospective developments, the model neither predicts when developments will occur nor provides specific measures and estimates.

He presents some innovative views on long-term public policy in agriculture. Government decisionmakers may find his book useful, particularly in the areas of price and income policy. Firm decisionmakers may also find the book useful. For example, many planning decisions to develop new farm equipment require an 8-10 year leadtime. University personnel may find this book useful in their long-range planning of research, teaching, and extension.

Cochrane's book would be an excellent textbook for a course in the history of U.S. agricultural development. By studying the development of U.S. agriculture, foreign students might learn something about development opportunities in their countries. The book would also be useful to students of agricultural policy, resource economics, and marketing.

* The reviewer is the managing director of the Farm Foundation.

EDWIN G. NOURSE—ECONOMIST FOR THE PEOPLE

Joseph G. Knapp,
The Interstate Printers and
Publishers, Inc, Danville, Ill., 544 pp.,
$11.95

*Reviewed by Vivian Wiser**

Edwin G. Nourse, as an economist interested in institutions, had a philosophical bent and a background in history, sociology, and political science. Nourse made significant contributions to agricultural economics—especially cooperative marketing, industrial organization, public policy formulation, and economic and social science thought. He examined the dichotomy between the natural science economist and the social science economist, a division rarely explored.

Knapp's biography is also the story of the relationship of its author, who was himself a distinguished teacher, Brookings scholar, and public administrator of farmer cooperative activities, and Nourse, an economist deeply interested in cooperatives. Soon after Nourse became director of the Institute of Economics (subsequently part of the Brookings Institution), he asked Knapp to join his staff and coauthor *Cooperative Marketing of Livestock.* Although Knapp left Brookings in 1939, the two men continued their association until Nourse's death in 1974.

Knapp approaches his subject from the framework of Nourse's publications, which he supplements by interviews conducted for Cornell University, correspondence with Nourse's associates, and material from Nourse's files. Nourse's life was characterized by an ever-widening scope of interest—from a student of engineering to one of history, economics, and other social sciences; from a teacher in a Utah high school to a professor at Stanford University and North Carolina State University; from the director of the Institute of Economics of the Brookings Institution to the chairman of the President's Council of Economic Advisors; and finally as a senior statesman involved in the work of the Joint Council on Economic Education. Nourse was active in the American Farm Management Association (now AAEA)—as editor of its journal—and in the American Economics Association; he served as president of both organizations. He was also chairman of the Social Science Research Council.

When Nourse published his book on agricultural economics in 1915, it was a relatively new area of study; marketing was an important element. He became interested in cooperative marketing and its place in U.S. economic life. He was active in the cooperative movement in the twenties and was one of the founders of the American Institute of Cooperation. He wrote and spoke on the subject of cooperatives for many years. According to Knapp, Nourse was among the first to understand that the farming industry could develop effectively only through integrated cooperative associations that brought farmers together in strong business associations.

The years at Brookings exemplified the impact that the economist's mind and personality would have. His publications, such as *Marketing Agreements under the AAA, Three Years of the Agricultural Adjustment Administration, America's Capacity to Produce, and Price Making and Democracy*, were widely read.

President Truman recognized Nourse's leadership in 1946 when he appointed him as first chairman of the Council of Economic Advisors. The new chairman realized the importance of his role as economic advisor to the President and the impact that the annual economic report would have on policy decisions. He opposed activities of Council members that had political connotations, including recommendations for Presidential action or testifying before congressional committees. Other members of the Council were frequently at odds with Nourse on this issue, and although this conflict led to his resignation in 1948, his concern as to his impact on the Council and its future continued. His *Economics in the Public Service* was published in 1953. Shortly before his death in 1974, some social scientists who were concerned that the Council of Economic Advisors was becoming too politicized pointed out Nourse's warnings that it should be advisory in nature.

After he left the Council of Economic Advisors, Nourse devoted his time to the Joint Council of Economic Education. During the fifties, he was troubled by what he termed the development of "political agrarianism, political laborism, and political businessism," whose proponents tended to look to the State to achieve their aims. He feared the prospects of inflation and militarism that, as a result of the Korean conflict, would threaten our national life. Although he was not actively involved in the Joint Council after 1964, he never lost interest in its work.

In his later years, despite failing vision, Nourse began work on a book on contemporary social science that he hoped would help troubled young people of the sixties. He believed that democracy, which

* The reviewer is a historian with the National Economics Division, ESCS.

is the essence of our political system, was being altered by the challenges of the so-called "new confrontation." Knapp reviewed the manuscript, but Nourse did not complete it. Nourse's contributions to the Legal Defense Fund of the National Association for the Advancement of Colored People, the Centennial Campaign of Hampton Institute, Lewis Institute, Antioch Law School, The University of Chicago, and Meharry Medical College represent yet another measure of the man's civic breadth.

Knapp's biography reflects his own strong personal association with his subject as well as professional respect. In 1969, Knapp dedicated his book, *The Rise of American Cooperative Enterprise, 1620-1920*, to Nourse as the "Dean of Scholars in American Cooperative Enterprise," and Nourse was pleased with the dedication. The present biography contributes to economic literature by its portrayal of the career of an outstanding economist during a 50-year period of change unmatched in U.S. economic life.

•U.S. GOVERNMENT PRINTING OFFICE : 1980 0-310-945/ESCS-215

Suggestions for Submitting Manuscripts for *Agricultural Economics Research*

Contributors can expedite reviewing and printing of their papers by doing these things:

1. SOURCE. Indicate in a memorandum how the material submitted is related to the economic research program of the U.S. Department of Agriculture and its cooperating agencies. State your own connection with the program.
2. CLEARANCE. Obtain any approval required in your own agency or institution before sending your manuscript to one of the editors of *Agricultural Economics Research*. Attach a copy of such approval to the manuscript.
3. ORIGINALITY OF MATERIAL. It is our policy to print original material. We consider alternative treatments of material published elsewhere, but such treatments need to differ substantially from the original approach. When submitting your manuscript, identify, if applicable, related material either published or submitted for publication.
4. ABSTRACT. Include an abstract and at least three keywords when you submit your article. The abstract should not exceed 100 words.
5. NUMBER OF COPIES. Submit three good copies.
6. TYPING. Double space everything, including abstract and footnotes.
7. FOOTNOTES. Number consecutively throughout the paper.
8. REFERENCES. Check all references carefully for accuracy and completeness.
9. CHARTS AND OTHER ARTWORK. Use charts sparingly for best effect. Keep design as simple as possible to improve communication. Submit all artwork in draft rather than final form, accompanied by neatly prepared pages with essential data for replotting.

The Secretary of Agriculture has determined that the publication of this periodical is necessary in the transaction of public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director, Office of Management and Budget, through February 28, 1985.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. $6.50 a year domestic; $8.25, foreign.

Microfiche copies are available from two different sources: Microfilming Corporation of America, 21 Harristown Road, Glen Rock, NJ 07452, 1974 on: $4.95 per year or per issue; Congressional Information Service, Inc., P.O. Box 30056, Washington, D.C. 20014, 1973: $5 (2 fiche), 1974 on: average is 3 fiche per year ($3.75 first fiche, $1.25 each remaining fiche.)

UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D.C. 20250

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF
AGRICULTURE
AGR 101
THIRD CLASS